The Weekly Newsmagazine of Science

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Puzzling Over Cold Fusion

Books

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The Ancient Egyptian Book of the Dead — translation by Raymond O. Faulkner; Carol Andrews, Ed. Transcribed onto papyrus and placed in the tombs of important Egyptians to aid them in their passage through the Underworld to the heavenly Field of Reeds, the Book of the Dead was fundamental to Egyptian religious doctrine for almost 3,000 years. This translation includes nearly 200 prayers, spells and incantations to repel the dangers of the Underworld, accompanied by several vignettes taken from illustrated copies of the text. U of Texas Pr, 1991, 192 p., color/b&w illus., paperback, $19.95.

The Cartoon Guide to Physics — Larry Gonick and Art Huffman. A whimsical yet educational romp through mechanics, electricity and magnetism — an ideal way to review physical principles that could never before hold your interest! Learn about velocity, gravity, collisions, voltage, circuits and more. Written for adults and young adults. HarperPerennial, 1990, 207 p., illus., paperback, $8.95.

The Concise Oxford Dictionary of Earth Sciences — Ailsa Allaby and Michael Allaby, Eds. Includes more than 6,000 alphabetically arranged, cross-referenced entries drawn from climatology, geology, oceanography, mineralogy, paleontology and other earth sciences. Oxford U Pr, 1991, 410 p., paperback, $9.95.

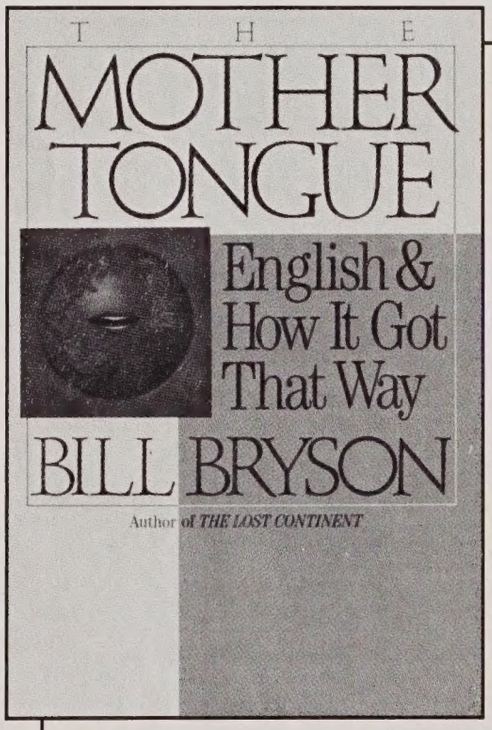
The Enigma of Suicide — George Howe Colt. Between 1 and 2 percent of Americans die by suicide, according to Colt. Determined to dispel the cultural taboo surrounding the subject, he embarks on an exhaustive exploration of suicide's social, cultural and legal history; suicide-related research, ranging from genetics to psychoanalytic theory to the effects of television; prevention efforts and support resources for bereaved relatives; "right to die" issues; and what suicide may mean in the minds of people who decide to kill themselves. This compassionate account is based on hundreds of interviews with survivors of suicide attempts, friends and relatives struggling to cope with suicide losses, and professionals who work with suicidal individuals. Summit Bks, 1991, 575 p., hardcover, $24.95.

In the Mind's Eye: Visual Thinkers, Gifted People with Learning Difficulties, Computer Images, and the Ironies of Creativity — Thomas G. West. Explores the complex interactions among creative ability, visual thinking and learning disabilities, explaining how certain traits considered problematic in traditional educational systems may confer an advantage to those relying on a visual approach to problem solving. Includes a discussion of learning difficulties experienced by several of history's most creative intellects, including Albert Einstein, Thomas Edison and Lewis Carroll. West proposes that new computer technologies may bring a shift toward more visual thinking, encouraging the innovation of visual thinkers. Prometheus Bks, 1991, 359 p., b&w plates, hardcover, $24.95.

Nature's Thumbprint: The New Genetics of Personality — Peter B. Neubauer and Alexander Neubauer. A father and son, psychoanalyst and science writer, make a case for nature over nurture in the development of human personality and physiology. Writing for the general reader, they cite two recent major surveys of twins raised apart to show that the genetic component is significant and interacts with environment in its influence on development. Originally published in hardcover in 1990. Addison-Wesley, 1991, 223 p., paperback, $10.95.

Physiology of Sports — T. Reilly, N. Secher, P. Snell and C. Williams, Eds. This well-referenced, academic analysis of the physiological requirements of major sports opens with a general chapter on energy stores, muscle morphology and aerobic and anaerobic metabolism. Each of the following chapters briefly introduces a specific type of sport and its history, then outlines its physiological demands, the characteristics of individuals who excel at it, factors that can influence performance, and common training strategies. Written for the serious reader with a basic understanding of physiology. Routledge Chapman & Hall, 1990, 495 p., charts & diagrams, paperback, $37.50.

The Population Explosion — Paul R. Ehrlich and Anne H. Ehrlich. The authors examine ways to ease the burden of overpopulation, which contributes substantially, they say, to problems as diverse as African famine, global warming, acid rain, pollution, the garbage crisis and AIDS. Originally published in hardcover in 1990. S&S, 1991, 320 p., paperback, $9.95.



"More than 350 million people in the world speak English and the rest, it sometimes seems, try to." Thus begins Bill Bryson's engaging jaunt through the quirks and by-ways of the world's most important—and baffling—of languages. No other language has achieved such eminence, overcome such odds, inspired such majesty of thought or caused such confusion as English.

Bryson covers the entire history of language, from the first crude murmurings of Neanderthal man 30,000 years ago to the explosion of English as a global language in this century. We learn why *island, freight* and *colonel* are spelled in such patently unphonetic ways, and why *four* has a *u* in it but *forty* does not. We learn how some of the most cherished "rules" of grammar can be traced to an eighteenth-century English clergyman who had no formal training in grammar, why one of the most prolific contributors to the *Oxford English Dictionary* couldn't come to the publication party (he was an inmate at a hospital for the criminally insane), and much, much more. This is a book that will, like the English language itself, amuse, delight and occasionally astonish you.

—from the publisher

William Morrow and Co., 1990, 270 pages, 6¼" x 9½", hardcover, $18.95

"If it were not for the scholarship behind this book—you'll never find more information about the vagaries of English crammed into smaller space—Bill Bryson might well have called it not *The Mother Tongue* but *The Mother Tongue-in-Cheek.* A chuckle accompanies an unexpected nugget of fact on every page."

— Willard Espy, Author of *Have a Word on Me: A Celebration of Language*

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Cover: Two years after the controversial announcement that cold fusion had occurred in an apparatus resembling this electrolytic cell, most scientists have given up on the existence of this perplexing phenomenon. But a few investigators continue to find bits of evidence that convince them the cold fusion puzzle can be solved. (Photo: University of Utah)

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Letters

Risky business

Job stress does bad things to all of us, so it is not surprising that it can affect the processes going on as a baby prepares to enter our world ("Job stress: A risk for pregnant workers?" SN: 3/16/91, p.165). And video display terminals have been maligned for grievances ranging from screen glare and carpal tunnel syndrome to electromagnetic radiation from the inner parts of the terminal ("Good news for pregnant VDT workers?" SN: 3/23/91, p.190).

But perhaps a more insidious threat is the computer to which these terminals are attached — which can become the worst sort of Big Brother by keeping a microscopic watch on the "productivity" of the workers.

Workers may be intimidated out of taking needed bathroom breaks, for example, or unwinding for a minute or two after a telephone session with a difficult customer. The trouble is that the computer can keep track of every second of the worker's time and report it to the boss. This adds up to lots of stress.

It may be that the VDT manufacturers have done all that's needed to reduce electromagnetic emissions, and that the problems the workers experienced in the recent VDT study have to do with sitting still too long with the boss/computer watching too closely. That's stress!

Dan Larson
Downers Grove, Ill.

I take issue with the conclusion and some methods in Teresa M. Schnorr's epidemiologic study. In their research paper, Schnorr and her colleagues conclude: "The use of VDTs and exposure to the accompanying electromagnetic fields were not associated with an increased risk of spontaneous abortion in the study." This improperly led to media summary statements such as USA Today's March 14 headline, "VDTs don't raise risk of miscarriage."

Two shortcomings in the study reduce its value in determining whether pregnant women who operate VDTs have more miscarriages. For one, the study did not have a true control group, since VDT operators and non-VDT operators had similar exposure to the pulsed ELF (extremely low-frequency) radiation many experts feel is most harmful. Moreover, Schnorr specifically excluded miscarriages that occurred during the first 14 days of pregnancy, when 60 percent of spontaneous abortions normally occur (often without the woman's notice) and when animal research indicates that women are most vulnerable. Animal research had already shown that no radiation-related abortion increase was likely for the pregnancy phase Schnorr studied.

Schnorr acknowledged the control group problem in comments reported in the March 14 Washington Post: "Because the NIOSH researchers found similar ELF exposure levels among both VDT users and nonusers, Schnorr said the study does not indicate whether ELF exposure increased miscarriage risk."

Recent mouse experiments funded by Sweden's National Institute of Radiation Protection show that electromagnetic field (EMF) exposure during the first five days of pregnancy (the preimplantation period) almost

Letters continued on p.399

Fortnight of Flares Dazzles Astronomers

A series of spectacular flares erupted from a single region of the sun's surface during the first half of June, surprising scientists with their record-breaking brightness. "The intensity of these flares is shocking," says Alan L. Kiplinger of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colo., who coordinated observations of the outbursts by more than 100 ground-based telescopes worldwide.

The stage was set May 18 when GOES-7, a NOAA satellite monitoring the sun, detected a large number of X-rays from a portion of the solar surface just before the region disappeared behind the sun's western edge. On June 1, just before it reappeared on the eastern edge, the region broadcast a booming announcement: a two-hour outburst of X-rays so intense that it saturated the satellite's measuring equipment. The total X-ray output from this violent event exceeded that of any other solar outburst recorded since such measurements began in 1974, Kiplinger says.

Minutes later, observers detected the first of six major, visible-light flares as the eruptive area — now dubbed active region 6659 — began migrating westward across the solar disk. Five of these, detected from June 1 through June 15, saturated GOES-7's X-ray detector. This was the largest number of high-intensity solar flares ever known to erupt from a single region, says NOAA solar forecaster Willow Cliffswallow. She and other researchers suspect that the active region, which again rolled behind the sun's visible disk on June 15, will fizzle out by the time it reappears at the end of the month.

The flares held other surprises. Due to the relative positions and rotations of our planet and the sun, the eastern portion of the solar disk should only weakly affect Earth's magnetic field. But charged particles that spewed out from the flares — including the easternmost flare — caused a variety of geomagnetic disturbances, interrupting radio communications and extending a dazzling display of aurora borealis as far south as Colorado, Cliffswallow reports.

Image of solar disk depicts hydrogen emission from the brilliant flare (arrow) recorded June 9 with an 8-inch telescope at the Big Bear Solar Observatory in California. Bottom photo, taken by a 10-inch vacuum telescope at Big Bear, shows close-up view of the same flare.

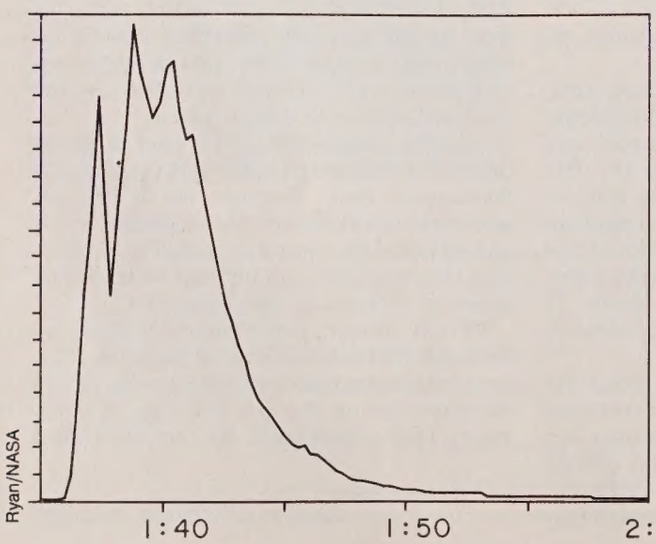
Photos: Big Bear Solar Observatory

Measurements with the Gamma Ray Observatory (GRO) may offer the best chance for understanding the solar phenomenon, Kiplinger and others note. One of GRO's four detectors, the Oriented Scintillation Spectrometer Experiment (OSSE), began focusing on the sun June 1 and managed to observe parts of five later flares, reports Ronald Murphy of the Naval Research Laboratory in Washington, D.C. On June 7, ground controllers rotated the orbiting observatory so that all four detectors faced the sun.

OSSE detected bursts of gamma rays — high-energy photons — from the sun at energies greater than 10 million electron-volts, Murphy told SCIENCE NEWS. Scientists believe solar flares erupt in a sudden release of energy when magnetic field lines snap or are abruptly annihilated in a localized area of the sun. The energy release causes streams of charged particles to head into space, and others to slam into atoms at deeper layers of the sun.

Some of those collisions excite the nuclei of the sun's atoms, causing them to emit characteristic gamma rays, Murphy notes. He says a preliminary analysis indicates that OSSE detected such emissions from carbon and oxygen atoms, among others — a finding that may help researchers deduce the relative abundance of elements in the lower layers of the sun's atmosphere. In other, more violent collisions, Murphy says, incoming charged particles rip apart the atoms, creating high-energy neutrons and gammas. OSSE appears to have detected neutrons, which should reveal the energy of the charged particles just before they hit the atoms.

GRO's Compton Telescope observed gamma rays bursting from two of the flares, and also appears to have recorded neutrons, says astrophysicist James M. Ryan of the University of New Hampshire in Durham. — *R. Cowen*



Ryan/NASA

Intensity of gamma rays at an energy of 70,000 electron-volts, recorded by the Gamma Ray Observatory's Compton Telescope during the June 9 flare. Curve shows several adjacent peaks over a 10-minute interval, possibly indicating emissions from neighboring areas within the active region.

Lighting the way to speedier circuits

The rate at which an electronic switch turns on and off is limited by the speed at which electrons travel through a semiconductor. Now, researchers have circumvented that limitation with the first switch controlled entirely by light. The new optical switch turns on or off at least 20 times faster than the maximum rate possible for an electronic system, they report.

"We use light to control light," says Alan Huang of AT&T Bell Laboratories in Murray Hill, N.J. "There are no semiconductors."

Previously reported "optical" switches incorporated semiconductor components and usually involved converting a signal from light to electrons, then back to light.

The new switch, together with recently developed optical amplifiers, completes the list of components necessary for building circuits in which light does all the work. "We have the makings of a new technology in optics that can go faster than electronics," Huang says. He described the switch's development and its implications for the design of optical computers at last week's Physics Computing '91 conference, held in San Jose, Calif.

Light travels through a medium such as glass considerably more slowly than it does in a vacuum. The new switch takes advantage of an extremely weak, barely discernible optical effect — namely, that bright light travels through an optical fiber slightly faster than dim light.

The Bell Labs researchers send a laser beam into a 100-meter loop of optical fiber, splitting the beam into two components that travel through the loop in opposite directions. The two separate beams produce an interference pattern where they meet again and recombine. Any slight change that disturbs one beam but not the other alters the interference pattern.

Injecting a short light pulse into the loop so that it travels in the same direction as one of the two interfering light beams makes this beam slightly brighter and speeds it up. The temporarily brightened segment of the beam arrives at the meeting place a fraction of a second earlier than it would otherwise, shifting the interference pattern.

The researchers use this brief, rapid shift in the pattern to control the exit of light from the device. Whereas a purely electronic switch takes at least 10 picoseconds to turn on and off, the optical switch needs only 0.5 picosecond. "We think we can push that even lower," Huang says.

Although this technology can't yet be used to construct a supercomputer, scientists now have all the ingredients they need to create a rudimentary all-optical computer. Huang and his co-workers have already used their optical switches, along with optical amplifiers, to construct simple circuits. They are investigating ways of building more complicated circuits and have taken the first steps toward miniaturizing the optical components.

"There's a lot of work that still must be done," Huang says. But because the components needed to build optical circuits are relatively easy to obtain, "my prediction is that within a couple of years, all the major universities are going to be doing experiments like ours." — *I. Peterson*

Speeding the search for new human genes

A group of genetics researchers has proposed a new way of tackling the Human Genome Project, the $3 billion, 15-year federal initiative to decipher every gene in the blueprint for human life. The new scheme, they say, could shave several years and millions of dollars off the project, which began about a year ago.

The team, led by J. Craig Venter at the National Institute of Neurological Disorders and Stroke in Bethesda, Md., sketched out a rough picture of part of the human genome by identifying segments of genes that are turned on in the brain. Venter says such bits of genes — called expressed sequence tags — could serve as dots outlining the genome, providing researchers with starting points for locating and deciphering the code for all of the estimated 50,000 to 100,000 human genes.

Researchers in Venter's laboratory, together with geneticists at St. Elizabeth's Hospital in Washington, D.C., demonstrated their approach using molecular "libraries" of all of the genes actively functioning in the human brain. They chose to focus on the brain because its functioning requires 30,000 genes, 20,000 of which are thought to be used by no other body tissues.

Venter's group randomly selected and deciphered 609 short stretches of DNA from the molecular libraries. Because the libraries had been back-translated from messenger RNA — the chemical intermediate DNA uses to make proteins — these researchers knew they were working with genes that code for proteins, and not with the regulatory sequences of DNA or the "filler" segments that together constitute 97 percent of the human genome. The team reports in the June 21 SCIENCE that most of the deciphered bits matched known genes, but 230 of the tags identified genes never before discovered.

"We tried this approach to see if just a little bit of sequence from each gene would be enough to identify it . . . and it worked," Venter says.

He estimates that the technique could identify and decipher genes up to 1,000 times faster than the current approach, which requires geneticists to read the sequence of roughly 1,000 overlapping stretches of DNA to identify a single gene. With the new method, Venter says, "we can get partial sequences from 1,000 genes" with the same amount of effort. Moreover, because the partial sequences need to be read only once — instead of the multiple times now required — he calculates that the approach could slash the cost of reading one unit of DNA from the present $1 to $4 to just 12 to 15 cents.

In August, Venter will receive a $1 million grant from the Department of Energy (DOE) to apply the new technique to the Human Genome Project, which is jointly sponsored by DOE and the National Institutes of Health (NIH). He says he hopes to identify all of the genes functioning in the human brain within the next three to five years. If the technique is adopted by other gene-mapping labs around the world, all human genes can be identified by 1996, Venter predicts.

Benjamin Barnhart, who manages DOE's human genome activities, says his agency supports Venter's strategy because it "gives us a handle on the functional portion of the human genome." Barnhart expects the panel of outside experts who advise DOE and NIH on the Human Genome Project to discuss the proposal when they meet next week. At the same time, he stresses that the genome project's ultimate aim is to decipher every human DNA sequence, not just to locate protein-encoding genes. Venter's approach "hasn't in any way detoured us from the long-term goal of providing the scientific community with the sequence of the entire genome," Barnhart says. The DNA sequences interspersed among protein-encoding genes in the human genome could turn out to have surprising functions, he contends.

Elke Jordan, deputy director of the NIH's National Center for Human Genome Research, remains noncommittal about the new strategy. She says Venter's group has essentially refined an approach outlined a year ago by Maynard Olson at Washington University in St. Louis. Olson proposed identifying random unique DNA sequences — not just those that are part of genes — to expedite the Human Genome Project. When asked whether NIH will adopt Venter's technique, Jordan replied that the agency will use "whatever approaches make sense." — *C. Ezzell*

Tiny bubbles help plastics take a pounding

If you have ever sat in a canoe as it snagged on a rock and split open, you know the sinking feeling of discovering that a material couldn't quite do its job. Now, research into the mechanism of fracturing promises to aid engineers in their quest to balance weight, cost, toughness and flexibility for longer-lasting products — including, perhaps, indestructible boats.

Manufacturers usually assess the toughness of a compound by measuring the amount of energy needed to break a sample in half. But a plastic's toughness also depends on how it reacts to stresses leading up to the fracture, and engineers should consider this in designing new products, assert researchers from the University of Rochester (N.Y.) in the June JOURNAL OF MATERIALS RESEARCH.

James C.M. Li and two graduate students studied acrylonitrile-butadiene styrene (ABS), a plastic commonly used in canoes, recreational vehicles, bathtubs, pipes and even TV cabinets. Companies tailor ABS for its various uses by adjusting the amount, size and structure of the particles of butadiene, a rubber mixed in to make ABS less brittle.

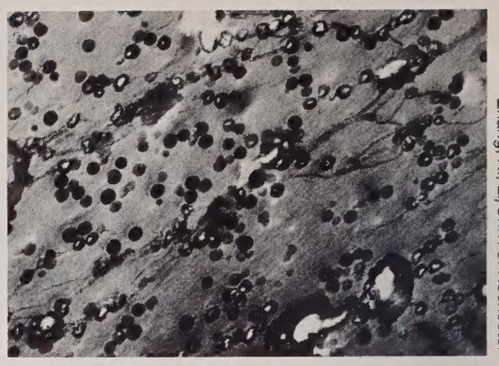
The Rochester group's findings about prefracture stress should help materials scientists achieve a more reasonable trade-off between toughness and other characteristics, says David E. Henton, an engineer with Dow Chemical Co. in Midland, Mich., which helped fund the work.

When the researchers analyzed what makes microscopic cracks worsen, they found that ABS materials vary in the amount of stress they absorb before they break. "You must put energy into it before the crack starts to go," Li explains.

ABS polymers can take up energy in any of three ways. Microscopic bubbles may form in the rubber particles. Sometimes the polymer molecules shear, slipping slightly away from those above and below. Also, a network of very fine cracks, called crazes, can develop, says Li.

He and his co-workers discovered that bubbles reduce stresses most effectively and that ABS polymers with larger rubber particles form more bubbles. This finding will aid in improving ABS because "you want to maximize the efficiency of the rubber phase," says Henton, who notes that rubber is the material's most expensive component.

Royalite Thermoplastics in Mishawaka, Ind., which makes ABS polymer for canoes, takes a different approach. Rather than alter the rubber component, the company sandwiches an ABS foam between two thin ABS layers, creating a material with more rubber per unit weight than a single thick layer would have, says Victor W. Lee, a technical manager with Royalite.



Zhang, Ni, Li/Univ. of Rochester

ABS plastics can absorb energy and resist breakage by developing crazes (dark streaks) and by forming bubbles inside rubber particles.

The resulting material satisfies most customers, according to canoe manufacturers. Nevertheless, "we keep telling them we want it stronger, stiffer and cheaper," says Wendall Easler, vice president of operations for Old Town Canoe in Old Town, Maine.

With the new report, says Henton, "one begins to better understand the critical interplay between these molecular variables." This knowledge, he says, might one day lead to a tougher ABS canoe with less rubber and perhaps a lower cost.

— E. Pennisi

Bereavement: How strength saps coping

A harmonious marriage, a solid bank account and a sense of control over life offer many rewards. But such sought-after assets also set the stage for a particularly difficult adjustment to the death of a spouse, according to preliminary data from the first large-scale study of adults both before and after bereavement.

"People with considerable [psychological and financial] resources may be at most risk for negative reactions to the loss of a loved one," says psychology graduate student Vicki Gluhoski of the State University of New York at Stony Brook. "If someone views the world as predictable and safe, bereavement may hit them especially hard."

Gluhoski, who conducted the study with Stony Brook psychologist Camille B. Wortman and sociologist Ronald Kessler of the University of Michigan in Ann Arbor, presented the findings at the annual meeting of the American Psychological Society in Washington, D.C., last week.

Their findings suggest that people involved in conflict-ridden marriages suffer less emotional distress following a spouse's death than those in stable marriages. This contradicts the traditional assumption, based on clinical observations, that the survivor of a tumultuous relationship faces major difficulties in resolving the loss of his or her partner, Wortman points out.

The data also undermine the widespread notion that people armed with a sense of self-worth, confidence in their ability to overcome obstacles through hard work, and other emotional resources fend best in the face of severe stress, such as bereavement.

"So far, the findings fly in the face of most theories about grief," Wortman asserts. "A Protestant work ethic type of world view can be very adaptive in many settings, but apparently not after the sudden loss of a loved one."

Wortman and Gluhoski's conclusions stem from an ongoing study of a national sample of 3,617 married men and women interviewed in 1986. Participants ranged in age from 25 to 65 years. In 1989, experimenters conducted second interviews with 2,800 members of the original sample. Between the two interviews, 100 participants — mostly women — experienced the death of a spouse.

Bereaved individuals who began the study with a variety of characteristics associated with good psychological functioning — including minimal marital conflict, positive self-image, feelings of control over the direction of their lives, and high scores on tests of verbal intelligence and attention — reported substantially more depression in 1989 than did bereaved individuals displaying essentially the opposite pattern. Depression also appeared more often among those who earned the most money prior to bereavement, regardless of what their spouses earned.

The researchers have yet to analyze data on anxiety, social activities and feelings of well-being following the death of a spouse, or the influence of reported religious faith on psychological adjustment to the loss.

An important check on the study's findings will come from a similar long-term project initiated in 1988 — also headed by the Stony Brook researchers — involving about 1,500 elderly, married people living in the Detroit area. Statistical analyses should proceed in the next year or two as the number of bereaved participants increases, Wortman says.

The new research complements previous findings that many bereaved spouses and parents become depressed and do not come to terms with their loss for at least four years (SN: 2/7/87, p.84), while a substantial minority show little distress after the loss.

— B. Bower

Camouflaged grafts elude immune detection

Two immunologists have devised a novel strategy for sneaking donor tissue past the body's immune system. Instead of subduing the system's watchdogs, they pretreat the tissue to mask its foreign "scent."

Like trained security dogs, T-lymphocytes roam the body and detect intruding foreign cells, which they quickly attack and kill. But in the June 21 SCIENCE, researchers report avoiding rejection of human cells grafted into mice by camouflaging the cells with antibodies.

Denise Faustman and Chuck Coe of Massachusetts General Hospital in Boston successfully transplanted human pancreatic islets or liver cells into 25 mice after treating the tissues with antibody fragments that bind harmlessly to HLA class I antigens—the molecules that alert the patrolling T-cells to a foreign presence. With their telltale antigens concealed, the graft cells effectively became invisible to the immune system.

Ordinarily, physicians give transplant recipients powerful, immunity-suppressing drugs to help prevent rejection of the new tissue. However, weakening the immune system can expose a patient to deadly infections. Seeking safer alternatives, immunologists have recently focused on HLA class II antigens and other nonlethal ways of blocking T-cells, but their experiments have yielded only partial success. The latest approach, focusing on HLA-I, has startled and delighted researchers in the field.

"I'm surprised. It's very intriguing to use an antibody to class I. It makes sense, though," says pathologist Paul Lacy of Washington University in St. Louis.

"That's really exciting," says Gerald Nepom, an immunologist at the Virginia Mason Medical Center in Seattle. The Boston experiments provide a "dramatic illustration" of the new approach, he notes, because the researchers chose a strain of mice known for its relatively strong immune system.

Faustman says her work stemmed from studies in the 1980s showing that T-cells recognize and lock onto specific parts, or epitopes, of their target cells. It seemed an obvious step to try and hide those areas, she says.

She and Coe tried several approaches. In one, they incubated the insulin-producing pancreatic cells called islets with a solution of antibodies that bind to a wide range of epitopes. In another, they used an antibody fragment that binds only to the HLA-I sites. The HLA-I strategy proved just as effective as the broader approach, suggesting a key role for the HLA-I antigen.

In the HLA-I trial, the researchers confirmed the function of the grafted islet cells at 30 and 200 days by measuring human C peptide, an insulin-processing product not normally found in mice. They also confirmed the presence of the islets and the absence of attacking T-cells at each stage. Grafts of liver cells yielded similar success, they report.

Furthermore, says Faustman, the pretreated cells apparently "educated" the mouse immune system to ignore undisguised HLA-I antigens in subsequent transplants. Such tolerance is vital to the long-term survival of a transplant, since the antibody masks will eventually wear off, Lacy notes.

Although human trials probably won't begin for another five years or so, Faustman believes the HLA-I approach has great potential. "We think it's very applicable for cellular transplantations, and possibly for whole organs," she says. Transplanting just islets would be a great boon for insulin-dependent diabetics, she says, and successful grafts of protein-producing muscle cells could help those with muscular dystrophy. She also plans to experiment with central-nervous-system cells involved in Parkinson's disease.

Whole organs, such as kidneys and lungs, pose extra difficulties, but pretreating them might at least reduce the need for immunosuppression. "The concept we're working on is treating the graft so you don't have to use the terrible drugs on the patient," Faustman says. —*J. Travis*

Glowing evidence of gene-altered arteries

One of summer's delights is the pulsing glow of hundreds of fireflies dotting the dusky sky. New research suggests that this same power source can help light the way to a gene therapy for coronary artery disease.

A 1989 report of the first successful transfer of a bacterial gene into the leg arteries of live animals (SN: 6/17/89, p.373) took molecular biologists one step closer to the prospect of a gene therapy for humans who suffer from clogged arteries. Researchers have now added a luminous twist to such experiments, this time inserting dog arteries with the gene coding for luciferase — the enzyme that gives the firefly its "fire."

In one experiment, Judith L. Swain and her colleagues at Duke University Medical Center in Durham, N.C., anesthetized seven dogs and surgically exposed the femoral arteries of the legs. They then inserted catheters and flushed the arteries with a solution containing luciferase genes. The enzyme's glow, they reasoned, would signify gene activation. After three days, they removed the tissue and exposed it to a light-measuring device.

In six of the animals, the glow-meter readings indicated that the altered femoral tissue contained 1 to 77 picograms of luciferase, averaging about 20 picograms. This showed that the gene had traveled through the cell membrane and "turned on," directing the canine cell to secrete the firefly enzyme, Swain's group reports in the June CIRCULATION. In a separate experiment, the team transferred the luciferase gene into the coronary arteries of two dogs, later detecting 28 and 32 picograms of the enzyme.

While no one proposes injecting firefly genes into people, the study does brighten hopes that scientists may someday inject human coronary arteries with genes that code for powerful clot-dissolving proteins such as tissue plasminogen activator (TPA), Swain says. The inserted genes might turn artery cells into miniature TPA factories that churn out enough of the drug to prevent the blood clots that can trigger a heart attack, she adds.

People undergoing angioplasty, in which doctors use a tiny balloon to open clogged arteries, might be prime candidates for such gene therapy, Swain suggests. Although physicians currently give angioplasty patients intravenous injections of TPA, this doesn't always prevent the arteries from later reclogging or developing clots. Swain cautions, however, that a gene therapy to keep human arteries open will take many more years to develop. —*K.A. Fackelmann*

Pigs make human pigment

Genetic engineers have created the first pigs carrying the human gene for hemoglobin, the oxygen-carrying pigment in red blood cells. The feat may help scientists create an inexpensive, disease-free substitute for human blood, say researchers at DNX Corp. of Princeton, N.J., the biotechnology firm that developed the transgenic swine.

John Logan of DNX presented data on one of the three pigs this week at the World Congress on Cell and Tissue Culture, held in Anaheim, Calif. Ten to 20 percent of this pig's hemoglobin is the human variety, he says.

Logan also outlined a simple method for breaking open red blood cells and separating the swine and human hemoglobins—a crucial step toward producing a human blood substitute.

DNX President Paul Schmitt notes that isolated hemoglobin stores at room temperature for six months to a year, significantly longer than whole blood. The company plans to pasteurize the hemoglobin, a process that reduces the risk that a blood substitute will harbor disease-causing microbes.

DNX must complete animal testing and conduct human trials before the pig-produced pigment can obtain federal approval, Schmitt adds. □

Cold ConFusion

Despite ridicule from their colleagues, a few scientists struggle to verify a hotly contested claim

By ELIZABETH PENNISI

A few weeks ago, physicist Frank E. Close visited Los Alamos (N.M.) National Laboratory to promote his book, *Too Hot To Handle*, which pans the discovery of so-called cold fusion. Yet even as he spoke, a handful of researchers were hard at work in one of the lab's tunnels trying to decipher just what cold fusion is really all about.

Like dozens of others in the United States, and perhaps hundreds across the globe, these investigators refuse to trash the notion of cold fusion. They continue to seek evidence of the controversial phenomenon, two years after the first round of follow-up studies failed to support claims that a new kind of nuclear reaction had emerged in bench-top experiments at the University of Utah (SN: 4/1/89, p.196).

And with each suggestive new finding, these researchers grow increasingly confident. They insist that their observations are rooted in real measurements, not experimental artifacts — despite the ridicule of their fellow scientists, who dismiss such results as sloppy science, unrecognized error, wishful thinking or even fraud.

"I think it is inappropriate for people to say we don't know how to run our experiments," argues Charles D. Scott, a chemist who has investigated cold fusion at Oak Ridge (Tenn.) National Laboratory. "There are enough people who have seen these results. It is absolutely real."

Nonetheless, the tone of next week's Second Annual Conference on Cold Fusion will likely be far from triumphant. Most of the 200 investigators expected to converge at this international meeting in Como, Italy, will swap tales of frustration. They have seen, and in some cases continue to see, signs of excess heat or nuclear events in their experiments. But they still cannot guarantee that anyone — including the experimenters themselves — can reproduce those results, because they still do not know what triggers the odd reactions (SN: 4/7/90, p.212).

This business of sparking fusion in a bottle sounded incredibly easy as originally described by chemists B. Stanley Pons and Martin Fleischmann. But the experimental setup has proved incredibly complex, requiring a mix of expertise seldom found in any one person or even in any one institution.

"If Pons and Fleischmann exaggerated, then the worst exaggeration they made is that this was a simple experiment," contends Edmund K. Storms, a materials scientist pursuing cold fusion at Los Alamos. "It's one of the most chemically complex environments that I have had to deal with."

Cold fusion setups require finesse in metallurgy, chemistry and physics. Results, if any, usually take days or weeks to appear, and then do so sporadically and unpredictably. "After a period of time, something in your experiment changes and you no longer have the same results," says physicist Edward Cecil of the Colorado School of Mines in Golden.

Moreover, cold fusion's dramatic implications — both for science and for society — can color interpretations of results. A widely accepted confirmation of the phenomenon could drastically upset conventional nuclear physics. At the same time, it would hold out the seductive prospect of producing enormous quantities of "clean" energy, not to mention riches and fame for those who harness the process. With so much at stake, researchers have trouble objectively evaluating experimental findings.

Nevertheless, groups in the United States, Italy, India, Spain, the Soviet Union, Japan and China plod forward, attempting to create cold fusion through a variety of techniques. In general, they all try to load as much deuterium (a hydrogen isotope) into a metal, usually titanium or palladium, and then look for evidence that something unusual has occurred.

Some have detected heat, as measured by calorimeters. Others have detected neutrons, charged nuclear particles, helium (SN: 3/23/91, p.180) or tritium, the triple-heavy hydrogen isotope. All of these observations suggest that some kind of interaction occurs among the deuterium nuclei, asserts Bombay physicist M. Srinivasan in his review of cold fusion experiments, which appears in the April 25 CURRENT SCIENCE, a journal published in India.

No one is sure whether that interaction is really fusion in the conventional sense, however. So for now, the researchers simply continue with their experiments, improving their faith in the validity of the results, as they strive to develop a formula for consistently triggering cold fusion events.

"Until you have a recipe for doing it reproducibly, there will always be justifiable criticism," says Bruce E. Liebert, a materials scientist at the University of Hawaii at Manoa. "Until you do that, you can't do good science. That's the single most important question to address in this field right now."

Yet the investigators insist they are making progress. At a conference this spring in the USSR, for instance, Soviet scientists presented 80 papers, more than half of which described experimental results "that roughly mimicked results reported around the rest of the world," says David H. Worledge, a program manager in the nuclear power division of the industry-funded Electric Power Research Institute (EPRI) in Palo Alto, Calif. None of this work proves that cold fusion occurs, Worledge says, but the data make that possibility more difficult to ignore. "All are inconclusive, but a fairly substantial weight of evidence is building," he maintains.

At next week's meeting in Italy, organizers expect scientists to present some 100 papers, most of them detailing new experimental results. And this month, the American Institute of Physics will publish 70 papers in the proceedings of last October's conference, "Anomalous Nuclear Effects in Deuterium/Solid Systems," held in Provo, Utah.

From the recent work, researchers have gleaned several insights about what they must do in their experiments. They now realize that the way deuterium gets into the palladium — as well as how rapidly and to what degree it does so — can be critical to their success. EPRI-funded researchers stress the need to load the palladium with almost as many deuterium atoms as palladium atoms. Joseph Santucci, a nuclear engineer and program manager at EPRI, surmises that many investigators may have trouble getting their experiments to work be-

cause they lack the ability to measure the number of deuterium atoms present and thus cannot be sure they have achieved a high enough ratio. Other scientists suggest that loading the deuterium too rapidly or too slowly decreases the chances of sparking the elusive reaction.

In addition, many investigators have improved the purity of their starting materials and experimental apparatus. Others have shown that the amount of electrical current used or the way it is delivered can be critical. A few think cold fusion depends on somehow jolting the materials into a state of disequilibrium. Fleischmann, working at the University of Southamptom in England, now focuses on deciphering the chemical events on the palladium surface, which he thinks may play a crucial role in cold fusion.

While some data suggest that the phenomenon does involve interactions between deuterium nuclei, the products of these apparent interactions do not conform to the standard notions of nuclear physics. According to those principles, fusion of deuterium nuclei should lead to any of three pairs of products: a helium isotope and a neutron; a proton and a tritium nucleus; or helium and gamma rays, which have such high energy they should escape without generating excess heat. In cold fusion experiments, these products appear — but not in the right proportions.

For example, the yields of neutrons or tritium seen by several groups are too low to account for the excess heat measured, and they seem unrelated to whatever generates the heat. This has led investigators to suggest that cold fusion may be several reactions, reports Storms in a review article scheduled for the September FUSION TECHNOLOGY.

"The connection may only be that all these phenomena are taking place in the solid lattice," adds Fleischmann. "I think that is what makes the problem so fiendishly difficult."

The challenge of putting together this puzzle whose pieces don't quite fit has attracted a number of theorists. All have their own ideas about what might allow deuterium nuclei to get close enough to interact. However, says Worledge, "there are so many theories, we don't get much guidance from them."

He and most other cold fusion investigators focus instead on real-world results, looking for measurable fusion products such as excess heat, charged particles, tritium and neutrons.

Srinivasan's review paper tallies at least a dozen reports of excess power of 25 to 30 percent. Pons and Fleischmann and a separate team of EPRI scientists reportedly have achieved even higher energy-production rates, but neither group will discuss its results.

Others are more willing to share their data — and their frustrations.

At Oak Ridge, for example, Scott set up a closed system in which he ran experiments for hundreds, and in some cases thousands, of hours. At times during those 10 tests, he saw what seemed to be bursts of 5 to 10 percent excess power. "What we found with some tests is that when we went through perturbations, then we got the energy bursts," he explains. In one cell, his team induced excess energy and even neutron emission by decreasing the temperature of the solutions used. But Scott says he stopped working on cold fusion last January for lack of research funds.

At the University of Hawaii, Liebert and materials scientist Bor Yann Liaw obtained suggestive results last year from a different type of cold fusion experiment. They made a molten-salt electrolytic cell by heating lithium and potassium salts to nearly 400°C; the cell also contained a lithium-deuterium compound and a small palladium electrode. The researchers passed a low electrical current through the apparatus for several days and found that the cell yielded more energy, in the form of heat, than they put into it, Liebert says. When they boosted the density of the current, the excess power increased and lasted almost four days, until no more lithium-deuteride remained in the molten-salt solution.

The team has since tried the experiment several more times, Liaw says, but only one of those attempts yielded excess heat, which lasted for a day.

Several researchers report encouraging — though transient — observations of charged particles. At the Colorado School of Mines, Cecil detected low-energy charged particles emitted from thin titanium foils. He used high pressure to force deuterium into the titanium, then dunked the foil into liquid nitrogen to cool it. After several hours, his particle detector registered about 1,000 particles per second for up to two hours, then stopped. He repeated this procedure more than 25 times and saw positively charged tritium nuclei at some point in about half of the experiments.

For the past nine months, he has seen nothing at all and he's not sure why. "You have to be careful that you are not getting spurious electrical signals," he admits.

Nevertheless, Cecil says his control experiments convince him that what he saw was real, and he takes heart from some still-unpublished findings by George P. Chambers and his colleagues at the Naval Research Laboratory in Washington, D.C. "They have similar results under different experimental conditions," he says. According to Srinivasan, Cecil's data also fit with findings by Japanese researchers.

As for tritium, Los Alamos physicist Thomas N. Claytor got results by forcing palladium to absorb deuterium under high pressure, then pulsing a very high current at a moderate voltage through the apparatus. He found that this led to a higher tritium count than a low-current, high-voltage pulse. In another study, Storms' team at Los Alamos deliberately inserted tritium into a metal lattice and watched its behavior to learn what to expect from a palladium or titanium sample contaminated with tritium, which could give the false impression of tritium production.

Scientists looking for tritium as evidence of cold fusion find that this triple isotope seems to arise from very fine "hairs" that sometimes build up on the palladium surface. The voltage may concentrate there, providing the extra bit of energy to trigger fusion. But researchers don't know what controls the formation of these fine structures. "No one has the courage to stop [an electrolytic cell] while it is producing tritium [to look at the hairs]," Storms explains.

And by the time the tritium production stops, the palladium or titanium surface lies buried under a layer of crud. "So until we get this more reproducibly, you won't have a good idea of what's going on," says Storms.

Meanwhile, reports of tritium detection trickle in from many parts of the world, including India, Spain and Italy. In some cases, these scientists have detected neutron emissions along with the tritium.

Observations of neutrons also seem to be fairly consistent from one team to the next, although the experimental reaction yields low quantities of these nuclear components. "In general, the results on neutrons are the kind of results that start looking like truth," says Worledge. "They have turned up in the same way in several different detectors at the same time in different laboratories, even down in deep mines."

Cold fusion has remained true to its seemingly fickle nature in an experiment set up this spring at Japan's Kamiokande neutrino detector. The detector came up empty-handed in its initial neutron searches, suggesting the reaction simply wasn't happening. However, the project still has several months to go.

The scientific community continues to deride such pursuits, and the antipathy has taken its toll. On June 30, the National Cold Fusion Institute, set up in Salt Lake City almost two years ago with $5 million from the State of Utah, will close its doors for lack of money.

But a few die-hards still refuse to give up. "To write [cold fusion] off at this stage, I think, would be a mistake," says Santucci. "Right now, the most important thing is to continue the work in a low-key, low-profile way." □

Peer Review Under Fire

Science's gatekeeping system may need an overhaul

By BRUCE BOWER

Perhaps nothing arouses scientists' professional passions as much as peer review. After all, this process — a gatekeeping and quality-control system run by journal editors, independent referees and research program directors — determines which projects receive funding and which studies get published in what journals. When institutional bouncers rough up your cherished theory and dump your career aspirations on the doorstep, the wounds go deep. And even if the bouncers show respect, they may still inspire fear and doubt with each new grant proposal or manuscript submission.

Despite its crucial role in this era of "publish or perish," scientific peer review today limps along with its own disabling wounds, asserts Domenic V. Cicchetti, a psychologist with the Veterans Administration Medical Center in West Haven, Conn. In his comparative review of peer-review studies conducted over the past 20 years by various researchers, Cicchetti finds consistently low agreement among referees about the quality of manuscript submissions and grant proposals in psychology, sociology, medicine and physics.

These rampant reviewer rifts represent more than an inevitable clash of perspectives on the worth of any particular study, Cicchetti maintains. Scientists must act quickly to improve the quality of peer review, particularly "the rather arbitrary rejection of grant submissions [that] may prevent or seriously delay the implementation of worthy research endeavors," he argues.

Cicchetti examined studies of peer recommendations and publication decisions made by 18 scientific journals, including the JOURNAL OF ABNORMAL PSYCHOLOGY, AMERICAN SOCIOLOGICAL REVIEW, NEW ENGLAND JOURNAL OF MEDICINE and PHYSICAL REVIEW. Additional data came from grant reviews in chemistry, economics and physics conducted during the 1970s and 1980s at the National Science Foundation and the National Academy of Sciences.

Cicchetti's findings and his recommendations for pumping fresh life into peer review appear in the March BEHAVIORAL AND BRAIN SCIENCES, along with 34 responses solicited from researchers and editorial decision-makers. Many support Cicchetti's proposed reforms, although they differ in their interpretations of the importance of disagreements among reviewers evaluating the same paper or proposal. Others reject the reforms, arguing that referee agreement — known as "reliability" when analyzed with statistics — has nothing to do with quality peer review.

Cicchetti remains undaunted. In addition to noting generally poor reliability among referees, he finds them more likely to agree about which grant proposals do *not* deserve support than about which proposals have scientific value. The same pattern applies to manuscript submissions in disciplines with a general focus, such as general physics, cultural anthropology, social psychology and broad fields of medicine such as cardiology and psychiatry, he says.

Conversely, in disciplines with a specific focus — including nuclear physics, physical anthropology, experimental psychology and biological specialty areas such as physiological zoology — Cicchetti finds that reviewers agree more often about worthy manuscript submissions and less often about rejects.

Journals dealing with specific areas of scientific inquiry have higher article acceptance rates and use fewer referees than journals covering general disciplines, Cicchetti points out. Editors of the more specialized publications usually rely on only one initial reviewer; a "thumbs up" review sparks publication approval from the editor, pending suggested revisions, while a "thumbs down" leads to solicitation of one or more additional reviews. General-focus journals often solicit two independent reviews; editors reject a manuscript with two negative reviews, solicit a third evaluation for split reviews and accept papers with two favorable reviews, pending revisions.

Grant proposals receive at least two independent reviews, and sometimes five or more evaluations. Reviewers rate the quality of a proposal on a numerical scale that varies from one funding outlet to another. All the scales contain a strict cutoff score for grants worthy of funding.

Scores often cluster just above or below the cutoff, Cicchetti notes. The inability of referees to agree on the relative quality of these borderline proposals justifies concerns that many worthy projects never win funding, victimized by the draw of reviewers or the proposal's emphasis on a relatively new or unfashionable realm of research, he says.

As for publishing research results, Cicchetti harbors less concern for rebuffed manuscript authors in both general and specific areas of social and medical science, since these researchers invariably succeed in publishing their rejected articles in other journals, often with few or no changes. In contrast, authors in the physical sciences usually do not submit rejected articles elsewhere, apparently regarding the initial peer verdict as decisive, Cicchetti says.

To improve the peer review process, he offers the following suggestions to editors and funding organizations:

- Send manuscripts to at least three independent reviewers carefully chosen for their area of expertise, such as content specialists or biostatisticians.
- Allow authors to request anonymity from reviewers.
- Encourage referees to take more responsibility for their comments by signing their names to each review.
- Solicit author reviews of referees for periodic evaluation by the editor or program director.
- Reward referees who provide consistently high-quality evaluations by inviting them to serve as consulting editors or members of key funding panels.
- Develop systems for peer-review appeals, particularly for grant submissions.
- Train reviewers by distributing guidelines for what constitutes a good paper, by showing them other reviewers' remarks on previously evaluated papers and by organizing practice sessions with feedback on reviews of sample articles.

The new findings and recommendations dovetail with recent reforms in peer review at the National Science Foundation (SN: 4/14/90, p.234) and find strong support in some quarters.

"This study holds a mirror up to peer review that provides a distinctly unflattering picture," says psychiatrist Kenneth M. Adams of the University of Michigan in Ann Arbor. "The remedial steps proposed by Cicchetti require urgent attention."

Cicchetti documents "a system that is seriously flawed," says psychologist Thomas R. Zentall of the University of Kentucky in Lexington. But asking reviewers to reveal their identities would not promote fairer reviews, he contends. Many referees, fearing retribution from a powerful senior author in the event of a negative review, would simply refuse to evaluate a large portion of submissions, Zentall says.

He adds that editors should carefully select reviewers who do not hold strong biases against the kind of research or direction of findings contained in a particular manuscript.

Fred Delcomyn, a neuroscientist at the University of Illinois in Urbana, says the best prospect for refining peer review lies in providing uniform, explicit review criteria and reviewer training. The peer-review process reliably classifies documents into broad categories, such as excellent, fair and poor, but counting on it to reveal finer distinctions "is like expecting to be able to measure the diameter of a nerve cell with a meter stick," Delcomyn maintains.

Extracting meaning from low reviewer reliability also proves tricky, says University of Illinois sociologist Lowell L. Hargens. Editors often choose referees with different specialties, and sometimes solicit evaluations from scientists representing both sides of a controversy — tactics that undermine referee agreement but hardly serve as an indictment of peer review, Hargens observes.

Moreover, editors reject many papers themselves before sending the survivors on for independent evaluations. If this practice weeds out the weakest or most inappropriate submissions prior to peer review, it also accentuates disagreement among referees struggling to rank the highest-quality reports, Hargens says.

Some scientific observers contend that even if referees viewed the entire spectrum of submissions received by journals and funding institutions, neither the reliability nor the validity of their decisions would likely improve. Peer-review validity lies in the ability to predict which articles or proposals will stimulate the most progress in a given field of study. The number of citations an article garners in the years following publication serves as one common marker of validity, although a report's citation record may largely reflect the degree to which it fits into a fashionable field of research.

The belief that basic research deserves generous funding because new understanding springs from unexpected, serendipitous sources — a cherished argument in scientific circles — implies that no one can accurately forecast which work most needs financing and publication, points out J. Barnard Gilmore, a psychologist at the University of Toronto in Ontario.

In addition, an individual's constantly shifting frame of reference greatly limits the consistency of human judgments and the level of agreement attainable in peer review, says psychologist Donald Laming of the University of Cambridge in England. He cites psychophysical experiments indicating that a volunteer's judgment about even a simple stimulus that occurs as part of a successive chain of stimuli — say, the frequency of a tone — varies depending on the qualities of the preceding stimuli. For example, as the number of different auditory frequencies in the chain increases, participants make more errors in identifying new frequencies, and those errors further cloud subsequent frequency judgments.

Laming says these findings suggest that two different peer reviewers, each with a unique and shifting frame of reference regarding a submission, stand little chance of agreeing any more often than the referees studied by Cicchetti.

Gilmore envisions a future in which journal and grant submissions reach a far-flung jury of scientific peers through computerized electronic mail. Rather than jostling for space in prestigious journals, authors would vie for the attention of prestigious reviewers and other readers who subscribe to the electronic peer network. Reviewers' computerized suggestions and ratings would determine a submission's funding or publication destiny.

In the meantime, some of Cicchetti's reviewers do not subscribe to his reform effort. They see no problem with low reliability among referees, and they claim Cicchetti misunderstands how a good editor or grant manager makes decisions.

"The purpose of peer review is not reliability, but to improve decisions concerning publication and funding," says epidemiologist John C. Bailar of McGill University School of Medicine in Montreal. Bailar served as editor of the JOURNAL OF THE NATIONAL CANCER INSTITUTE (JNCI) from 1974 to 1980.

Thorough peer review relies on comments from reviewers with a variety of perspectives and encourages disagreement, he contends. The editor pores over the responses, seeks opinions from editorial board members, and sometimes solicits the views of special consultants. At JNCI, Bailar says, this process led to the publication of some papers that all three reviewers had recommended for rejection, and vice versa.

Bailar argues that Cicchetti has no evidence to support his claims that larger numbers of reviewers, given training and instructions for reviewing, will improve decisions. Editors typically look beyond a submission's scientific and technical merit, evaluating originality, the topic's suitability for a given journal, the journal's need for a balance of topics, the importance of the findings to readers and the appropriateness of an article's length and style, Bailar observes.

"This notion of the editor having a very active role in the judgment of a manuscript seems lost on Cicchetti," remarks Charles A. Kiesler, a psychologist with Vanderbilt University in Nashville and an associate editor of AMERICAN PSYCHOLOGIST.

Cicchetti responds that the active editor who skeptically sifts through referee comments and consults other sources probably represents the exception, not the rule. Extensive reviews of publication decisions at the JOURNAL OF ABNORMAL PSYCHOLOGY, AMERICAN SOCIOLOGICAL REVIEW and PHYSICAL REVIEW point to reviewer recommendations as the major factor in an editor's ruling to accept or reject, he says.

Kiesler argues that reformers should focus instead on grant reviews, where the ability of a single grant reviewer to "blackball" a submission proves particularly worrisome. For instance, he notes, if a funding agency averages reviewer ratings in making its grant decisions, and if funding for a project hinges on an average score near 100, one reviewer can deny funding to a grant proposal by assigning it an extremely low score. This problem plagues controversial and innovative research proposals, says Kiesler, who recommends that granting agencies reserve some funds for innovative projects and disregard the worst rating of any grant proposal.

Though serious flaws mar the current system, the recent findings and proposals seem unlikely to spur a new wave of peer-review research and reform, says Michigan psychiatrist Adams. Everyone complains about peer review, but no one does anything about it, he contends.

"One may find this more amusing later in one's [scientific] career than earlier," he adds. □

Astronomy

Ron Cowen reports from Victoria, British Columbia, at the Workshop on the Space Distribution of Quasars

Giant cluster confounds cosmology

Astronomers have discovered a cluster of 10 quasars that may represent the largest structure ever found in the universe — as well as one of the most distant. Covering a swath at least 650 million light-years long and 100 million light-years wide in the northern celestial hemisphere, this quasar cluster is only the third identified so far. Its discovery adds to a growing body of evidence challenging several theories commonly invoked to explain the evolution of the universe.

Roger G. Clowes of the Royal Observatory in Edinburgh, Scotland, and Luis E. Campusano of the University of Chile in Santiago used two telescopes to detect the quasars. About five years ago, Clowes and Campusano began using an automated scanning machine to examine and digitize tens of thousands of images from a photographic plate taken by the U.K. Schmidt Telescope in Epping, Australia. Keying in on such features as the brightness and color of the imaged objects, special software then selected about 200 likely candidates for quasars from among the myriad galaxies and stars depicted on the plate.

Two years ago, guided by their list of quasar candidates, the researchers made high-resolution observations of the same sky region using the 4-meter telescope at the Cerro Tololo Inter-American Observatory in Chile. The study confirmed about 20 of the 200 objects as quasars, based on their redshifts and spectra. Moreover, 10 of these turned out to be astronomical neighbors. Their redshifts all fell within the range of about 1.1 to 1.3, indicating that they sit relatively close together at a distance of perhaps 8 billion light-years from Earth, Clowes says. Three quasars identified in a nearby sky region in the 1980s may belong to the same group, he adds.

Clowes notes that the cluster appears to exceed the dimensions of the two other known quasar groups, discovered in 1982 and 1989. But because the newly identified cluster — as well as the one found in 1989 — may stretch beyond the boundaries of the photographic plates, their relative sizes remain unclear, he says.

Nonetheless, the average redshift of quasars in the newly found cluster indicates that Earth-based observers are seeing this structure as it existed when the universe was only one-third its current age. The discovery that a quasar group existed in such an early era confounds the standard assumption that the universe could not have grown so lumpy so soon after the smooth, uniform beginning of the Big Bang. Clowes and Campusano plan to examine photographic plates from other sky regions to find out whether other such clusters may have existed in the early universe.

Distant galaxy looks strangely normal

David J. Thompson and Stanislav Djorgovski recently launched a search for protogalaxies — distant, primeval galaxies undergoing their first major burst of star formation — by analyzing light emitted from high-redshift objects illuminated by quasars behind them. Although the spectroscopic survey has revealed only a few potential candidates so far, it has turned up an unexpected bonus: a previously unseen object that appears to be one of the most distant "normal" galaxies known.

To qualify as "normal," a galaxy must undergo relatively mild evolution and must lack a quasar, or "active nucleus," at its heart. Most faraway galaxies don't fit that description.

Thompson and Djorgovski, both from the California Institute of Technology in Pasadena, made their finding with the 5-meter telescope at Mount Palomar Observatory near Escondido, Calif. Thompson says the object, dubbed G033+3208, has a redshift just beyond 1, which dates it back to when the universe was only half its present age. This may be just one of many faint, "ordinary" galaxies that go undetected at great distances yet contribute a substantial portion of the energy generated in the universe, Thompson suggests.

Radio waves may trace distant clustering

Determining whether galaxies and quasars formed clusters early in the history of the universe can tell astronomers much about the distribution of matter and the evolution of structures in the cosmos. By focusing on distant and intense radio-wave sources, an astrophysicist has found evidence for large-scale clustering when the universe was less than half its current age.

Brilliant visible-light emissions from relatively nearby galaxies — ones less than about 1 billion light-years from Earth — permit astronomers to discern not only whether these celestial objects cluster, but also whether groups of these galaxies congregate in superclusters. In contrast, the faintness of more distant galaxies and quasars makes it all but impossible for astronomers to assess large-scale clustering far beyond the Milky Way — at least when using visible light.

However, many distant galaxies and quasars *do* emit intense radio waves. Michael J. West at the Canadian Institute for Theoretical Astrophysics in Toronto, Ontario, took a cue from the behavior of nearby galactic clusters, called Abell clusters. About 20 percent of them contain a large, elliptical and bright galaxy at their center, called a "cD" galaxy, he notes. Other researchers had previously established that a cD galaxy tends to emit visible light pointing toward another cD galaxy — if the neighboring galaxy resides within 150 million light-years. Astronomers had also found that the parent Abell cluster housing the cD galaxy exhibits a similar behavior — it tends to emit light toward a neighboring cluster located no more than 150 million light-years away.

Notes West: "It is certainly remarkable that the structure and orientation of cD galaxies, just a few thousand light-years in diameter, should somehow reflect the presence of large-scale clustering of matter on scales of millions of light-years."

He wondered if the orientation of radio-emissions from distant galaxies could play a role similar to that of visible-light emissions from cD galaxies. If the analogy held, then such distant radio emissions could literally point to superclustering that occurred when the universe was much younger.

To more completely examine his hypothesis, West reviewed radio-wave surveys of nearby cD galaxies. And "sure enough, in almost every case," he says, "the radio emission from the [nearby] cD galaxy was indeed strongly aligned with [visible-light emissions] and the cluster in which it was located."

Other researchers had investigated whether radio emissions from distant galaxies aligned with the direction of the fainter, visible-light radiation from these objects. A wide variety of surveys indicated that distant galaxies — those 5 billion to 16 billion light-years away — indeed emitted both types of radiation along roughly the same direction.

Then came the finding that helped clinch his argument, West says. An analysis of 600 distant galaxies revealed that 38 had neighboring quasars located within 150 million light-years. Radio emissions from all 38 pointed toward the quasars. West observes that such alignment appears highly similar to the clustering that takes place among nearer cD galaxies and Abell clusters.

"It's a leap of faith," admits West, to extrapolate from what's known about nearby galactic clusters to more distant ones "where all we can see is the radio emissions." But, he adds, "The most natural interpretation of these results would seem to be that they indicate a well-organized pattern of superclustering [among distant galactic groups] when the universe was less than half its present age."

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Biomedicine

Mom's symptomless herpes threatens baby

Herpes can be deadly for newborns who acquire the viral infection from their mothers during labor or delivery. To complicate matters, only about 25 percent of adults with genital herpes display telltale symptoms (SN: 6/28/86, p.410). Seattle-based researchers have now tested a group of mothers during labor for asymptomatic but infectious herpes, and have reached some disturbing conclusions. Their data suggest that such screening will neither identify all women who risk passing the virus to their newborns, nor allow physicians to save infected babies from a devastating outcome.

Zane A. Brown and his co-workers at the University of Washington identified 56 women with active, asymptomatic herpes infections among the 15,923 laboring women tested at two local hospitals between 1984 and 1989.

Type 1 herpesvirus, the "oral" form usually associated with cold sores, rarely infects the genitalia. However, says Brown, "our data indicate that when it is present [in the genitalia], it transmits more readily [than Type 2] to infants." Three of the five women (60 percent) with Type 1 herpes infected their babies, compared with seven of the 51 women (14 percent) with active Type 2 herpes, the researchers report in the May 2 NEW ENGLAND JOURNAL OF MEDICINE.

The Type 1 infection almost never harms a newborn, Brown observes. In his study, all infants contracting Type 1 herpes developed normally. By contrast, one of the seven infants with Type 2 herpes died, and four developed disabling encephalitis.

"The really big risk of neonatal infection and damage or death occurs if a woman first acquires [Type 2] herpes late in her pregnancy," Brown says. And fully one-third of the mothers with asymptomatic herpes in this study were experiencing their first, or "primary," episode of this periodically recurring disease, he adds. Although the infected infants were identified within 24 hours of birth — far earlier than usual — and immediately treated with antiviral drugs, "we didn't significantly change the ultimate outcome," Brown says. "Kids with Type 2 disease got sick no matter what we did."

He notes another unsettling finding: Unlike most adults, infants carrying antibodies to the Type 1 virus did not contract a milder-than-normal version of the Type 2 disease.

Fortunately, the more serious, Type 2 virus "transmits reluctantly," Brown concludes. But transmission may occur in unexpected ways. He and his colleagues speculate that in eight of the babies with herpes infections, physicians may have unwittingly opened a portal for the virus by inserting electrodes into the fetus' scalp to monitor prenatal heartbeats.

A gold-plated test for Lyme disease

Current tests for Lyme disease detect the antibodies produced when a person's immune system responds to *Borrelia burgdorferi*, the tick-borne bacteria that cause the disease. But because some people are slow to make such antibodies, the test doesn't always provide an accurate diagnosis. If left untreated, Lyme disease can cause chronic arthritic symptoms.

Scientists have now developed a prototype test that directly spots bits of *B. burgdorferi*. Working at the Rocky Mountain Laboratories of the National Institute of Allergy and Infectious Diseases in Hamilton, Mont., the group created gold-tagged antibodies that home in on two of the bacteria's surface proteins. The gold enables scientists to image bacteria-binding antibodies in the blood with an electron microscope, thereby clinching the microbes' presence, the researchers report in the June JOURNAL OF CLINICAL MICROBIOLOGY.

David W. Dorward, who directed the work, notes that most medical laboratories lack the electron microscopes needed to conduct the new test. However, he says, the gold-labeled antibodies could be adapted for use in a routine diagnostic test.

Computers

Ivars Peterson reports from San Jose, Calif., at the Physics Computing '91 conference

Navigating the information swamp

The ubiquitous lab notebook, with its dog-eared corners, stained pages and scribbled entries, may one day give way to an electronic analog that permits not only the recording of data but also the sharing of information among researchers scattered throughout the world. Researchers at Baylor College of Medicine in Houston have developed a sophisticated, computer-based scheme, called the Virtual Notebook System, that allows its user to gather, organize and annotate information selected from a variety of sources.

With such a notebook, a medical researcher interested in the diagnosis of a certain ailment, for example, can readily assemble a package consisting of X-ray images, personal comments, citations, journal articles, news items, electronic-mail extracts and other relevant pieces of information. Moreover, the researcher can instantly share that information with others who use the same system, even if they are thousands of miles away. "You can even write in someone else's notebook," says Kevin B. Long, who directed the project.

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Best suited for groups of researchers already linked by computer networks, the Virtual Notebook System may prove a crucial component of large collaborative efforts. Officials with the Superconducting Super Collider are investigating the system as a possible means of sharing and analyzing experimental data when the accelerator is eventually completed.

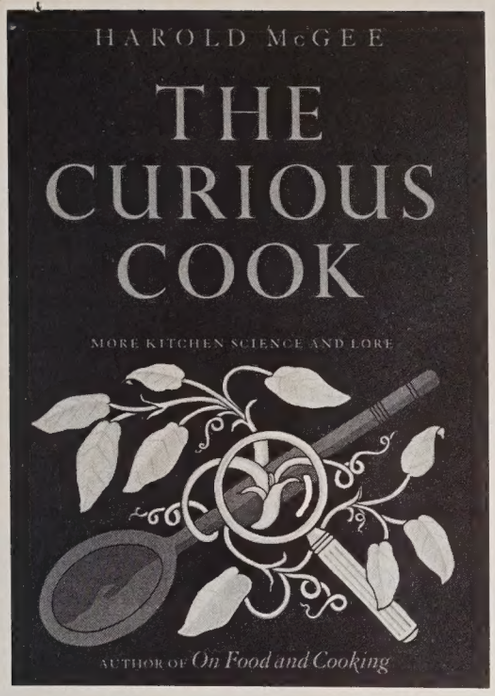
Exploring the virtual wind

Calculations of the direction and speed at which air flows past a complicated, three-dimensional object, such as an airplane, generate huge quantities of data. Conventional two-dimensional graphic images derived from these data often fail to convey the flow's complexity. Now, a team of researchers has assembled a primitive, prototype system for exploring such flow patterns, in effect allowing an investigator to step into and interact with a computer-generated environment.

Steve Bryson and Creon Levit of the NASA Ames Research Center in Mountain View, Calif., used commercially available components to create their prototype system, known as the Virtual Windtunnel.

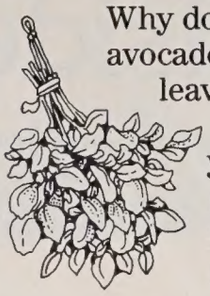
Through computer graphics and special input devices, the system creates the illusion of being surrounded by a flow. The user looks through a boom-mounted device resembling a diver's mask, which contains two small television sets to produce a wide-angle, stereoscopic image. A computer tracks the viewer's head position and generates the appropriate views. The user also wears a flexible glove fitted with sensors to manipulate the image in various ways. For example, to visualize the direction of flow in a particular region, a researcher can use the glove to specify the starting point for a computer-rendered stream of smoke, and then walk around to see the resulting flow pattern from different angles.

"It puts the computations right in front of the researcher," Bryson says. "It allows real interaction with the data."

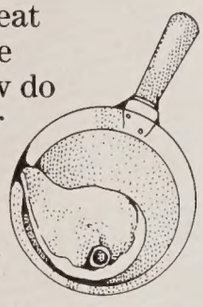


In this lighthearted and informative book, Harold McGee, author of *On Food and Cooking,* applies a scrupulous scientific method to his entertaining pursuit of culinary enlightenment. In the first of three sections, he experiments with traditional kitchen practices and the biochemical nature of various common foods, investigating the hows and whys of preparing jerusalem artichokes, guacamole, mayonnaise, persimmons and much more. In the second section, he addresses current dietary controversies surrounding heart disease, cancer and Alzheimer's disease, dispelling many time-honored myths and presenting a balanced outlook on diet and health.

McGee's final chapters cover historical attempts to understand cooking and eating as well as recent biological and chemical findings that offer a glimpse into the mysterious nature of gastronomical enjoyment. Packed with literary and historical anecdotes, this collection of browsable kitchen lore is bound to interest both active and armchair chefs.



Why do lettuce, avocados and basil leaves turn brown? And how can you retain the green in salads, guacamole and pesto?



Does searing meat really seal in the juices? And how do you keep tender meats from becoming tough by the end of a braise?

North Point Press, 1990, 339 pages, 6¼" x 9¼", hardcover, $19.95

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Letters continued from p.387

doubled placental resorptions of fertilized eggs. The Swedish team found no placental resorption increase when exposure began on day 7. The human preimplantation equivalent to this period is the first 6 to 9 days.

If these mouse findings directly related to women's pregnancy experience, VDT operators would have a very hard time having children. Radiation exposure during very early pregnancy would reduce normal live births from 500 to about 300 per 1,000 pregnancies.

James A. Doilney
President, Wellware Corp.
(radiation mitigation technology)
Park City, Utah

Blaming young victims

We were very disturbed by C.E. Wright's suggestion (Letters, SN: 3/2/91, p.131) that in some cases child abuse results from the behavior of the child rather than the behavior of the adult, and by Wright's call for research "to determine where the abuse cycle starts." This view joins in the venerable tradition of victim blaming, which apparently needs to be continually challenged.

We already have a rough understanding of the dynamics that lead to the repeated abuse of some children. "Deficient social skills" are all that abused children have had modeled for them in the home, and skills learned outside the home don't work there. Anger and "high levels of aggression" are in a sense appropriate responses to abuse. Placement in a foster home is a new and anxiety-filled situation, and children come to it with the only behaviors and coping skills they know. Foster parents are not trained to help children learn new coping skills, or even to know exactly what to expect. Abused children often can't tell what their limits or boundaries are until they are beaten up, and may push to that point in order to find out. In fact, they may have learned no other method for getting attention. Parents frequently apologize and give children extra attention after beating them, compounding the child's confusion and compulsion to elicit beatings. The *intent* of this "repetition compulsion" is to *avoid* becoming the victim, although its effect is further victimization.

What is surprising, given all that they have going against them, is that *only* about "one in three abused children displayed unusually high levels of aggression and deficient social skills" ("Charting the aftermath of child abuse," SN: 1/12/91, p.29).

Victim blaming may be a common reaction to situations in which people feel horrified and helpless to help the victim. If people realized why they have victim-blaming gut reactions, they might be able to step back and view these situations more clearly and constructively.

Sioux Hall
T.J. Ellermeier
Cambridge, Mass.

CORRECTION

In "Memories Might Be Made of This" (SN: 5/25/91, p.328), a mechanical production error transposed the top two pictures in the series showing how protein kinase C moves through the hippocampus when baby rabbits first open their eyes.

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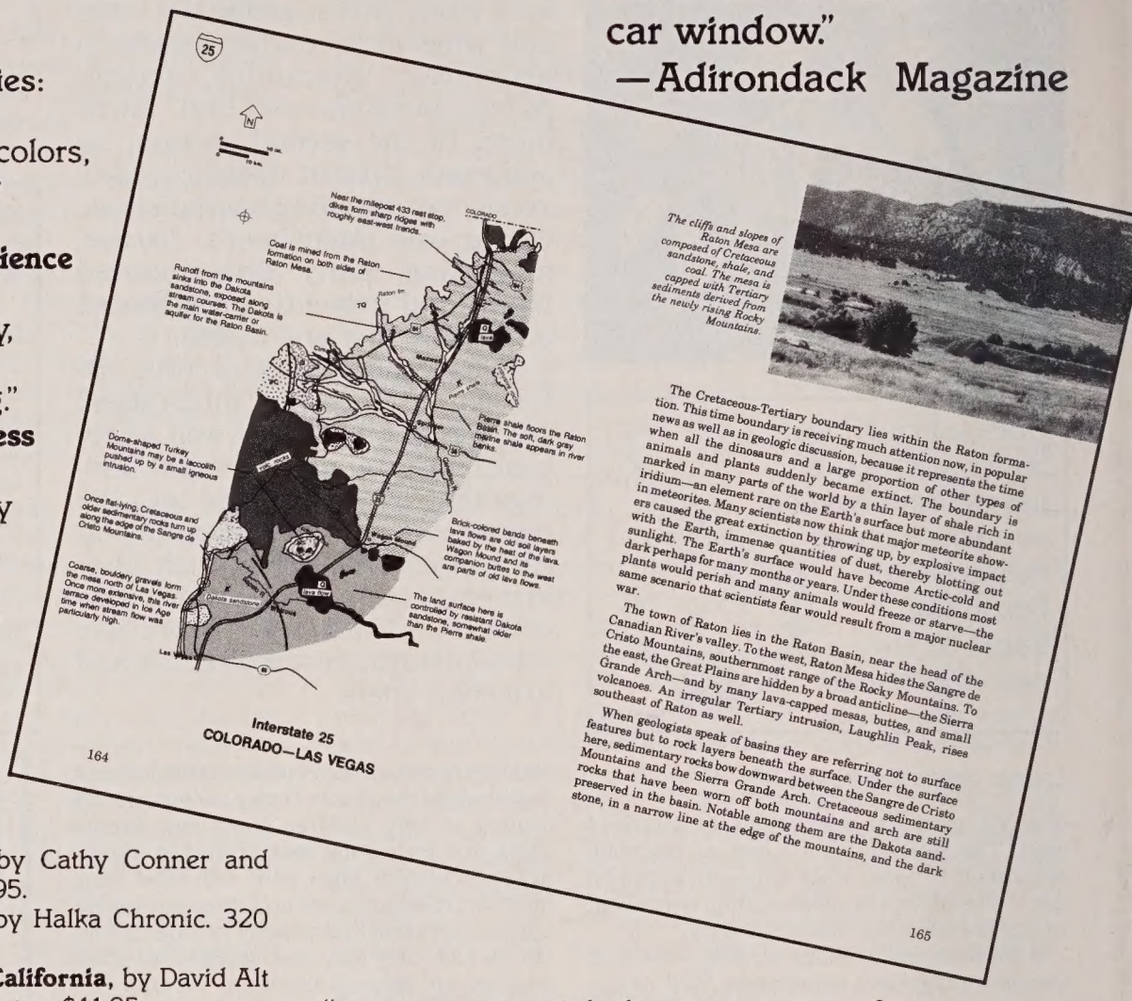
25
Near the milepost 433 rest stop, dikes form sharp ridges with roughly east-west trends.
Coal is mined from the Raton formation on both sides of Raton Mesa.
Runoff from the mountains sinks into the Dakota sandstone, exposed along stream courses. The Dakota is the main water-carrier or aquifer for the Raton Basin.
Pierre shale floors the Raton Basin. The soft, dark gray marine shale appears in river banks.
Dome-shaped Turkey Mountains may be a laccolith pushed up by a small igneous intrusion.
Once flat-lying, Cretaceous and older sedimentary rocks turn up along the edge of the Sangre de Cristo Mountains.
Brick-colored bands beneath lava flows are old soil layers baked by the heat of the lava. Wagon Mound and its companion buttes to the west are parts of old lava flows.
Coarse, bouldery gravels form the mesa north of Las Vegas. Once more extensive, this river terrace developed in Ice Age time when stream flow was particularly high.
The land surface here is controlled by resistant Dakota sandstone, somewhat older than the Pierre shale.
Interstate 25
COLORADO—LAS VEGAS
164
The cliffs and slopes of Raton Mesa are composed of Cretaceous sandstone, shale, and coal. The mesa is capped with Tertiary sediments derived from the newly rising Rocky Mountains.
The Cretaceous-Tertiary boundary lies within the Raton formation. This time boundary is receiving much attention now, in popular news as well as in geologic discussion, because it represents the time when all the dinosaurs and a large proportion of other types of animals and plants suddenly became extinct. The boundary is marked in many parts of the world by a thin layer of shale rich in iridium—an element rare on the Earth's surface but more abundant in meteorites. Many scientists now think that major meteorite showers caused the great extinction by throwing up, by explosive impact with the Earth, immense quantities of dust, thereby blotting out sunlight. The Earth's surface would have become Arctic-cold and dark perhaps for many months or years. Under these conditions most plants would perish and many animals would freeze or starve—the same scenario that scientists fear would result from a major nuclear war.
The town of Raton lies in the Raton Basin, near the head of the Canadian River's valley. To the west, Raton Mesa hides the Sangre de Cristo Mountains, southernmost range of the Rocky Mountains. To the east, the Great Plains are hidden by a broad anticline—the Sierra Grande Arch—and by many lava-capped mesas, buttes, and small volcanoes. An irregular Tertiary intrusion, Laughlin Peak, rises southeast of Raton as well.
When geologists speak of basins they are referring not to surface features but to rock layers beneath the surface. Under the surface here, sedimentary rocks bow downward between the Sangre de Cristo Mountains and the Sierra Grande Arch. Cretaceous sedimentary rocks that have been worn off both mountains and arch are still preserved in the basin. Notable among them are the Dakota sandstone, in a narrow line at the edge of the mountains, and the dark
165

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Computers

Ivars Peterson reports from San Jose, Calif., at the Physics Computing '91 conference

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